

Advanced Modular Platforms for Sea State Three Operations



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 - SS3 Causeway System
- Approach
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Significant Investment in Sealift ...

- \$6B Large Medium Speed Roll-on/Roll-off (LMSR) ship acquisition program (since 1990)
- FY98 (O&S): \$ 641M Afloat Prepositioning Ships (MPS, AWR-3, USAF)
\$ 302M Ready Reserve Force (RRF)



...But need to offload cargo in-stream

- Need flexibility to offload where austere, damaged, or no ports exist.
 - 90% *Desert Shield/Desert Storm* cargo moved by sea
 - *Fixed Ports of Debarkation*: tempting targets of opportunity





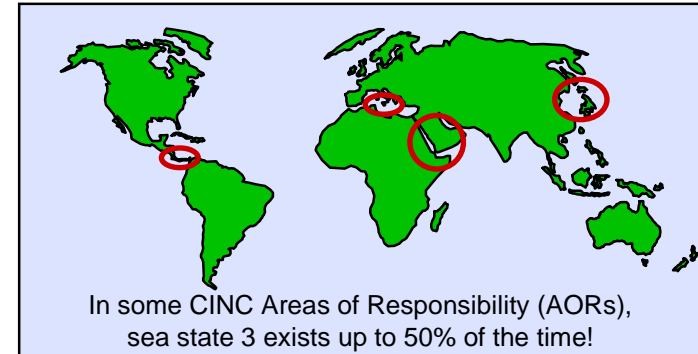
CINC Requirements

- **Sustain safe operations in sea state 3**
- **Service interoperability**



A WAR STOPPER

- Example: Some ship offload operations were curtailed in Somalia due to inability to operate in higher sea states...
- ...But sea state 3 is a worldwide problem.



Requirement Identified By

- CINCs: Integrated Priority List (PACOM, SOUTHCOM, TRANSCOM)
- CINC Messages:
 - USSOUTHCOM Msg 211600Z Jul 95
 - CINCPACFLT Msg 212020Z Jul 95
- Defense Science Board, Sep 96
 - "Programs like sea state 3 JLOTS should be accelerated"
- JCS JLOTS Report, Nov 96
 - "DoD would be best served by a single sea state 3 causeway system. A single DoD causeway system would allow the unified commanders maximum flexibility and reduce overall support and training costs."
- Letters of Endorsement:
 - JCS J4
 - EUCOM
 - USPACOM
 - TRANSCOM

Solution

System of Systems

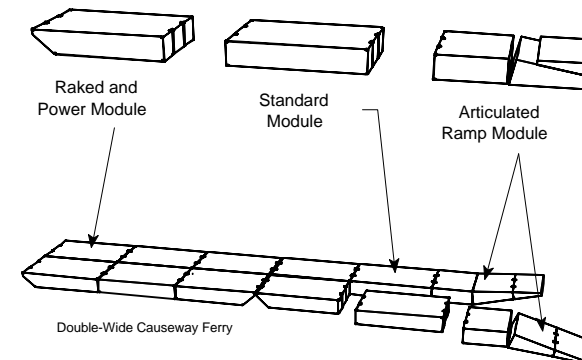
- **Ship Operations**
- **Sea State Mitigation**
 - Rapidly Installed Breakwater (RIB)
- **Cargo Movement**
 - SS3 Shipboard Cranes
- **C2 and Training**
 - Lighter Traffic Management System
- **Mooring / Fendering / Ramp-Lighter Interface**
 - Ramp-Platform Follower System
- **Ship-to-Shore Ops**
 - **SS3 Causeway System (#1 Priority)**

Approach (SS3 Causeway System)

- **Government/Industry Research & Development to validate achievable operational requirements**
 - Modular causeway system concept
 - SS3 connection system
 - Hull materials
 - Joystick control / dynamic mooring
 - etc.
- **Advanced Concept Technology Demonstration**
 - 3 Phase I contracts executed against performance specification
 - 1 Phase II contract to design, fabricate & demonstrate
- **Acquisition**

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Amphibious Cargo Beaching (ACB) Lighter



Platforms: Causeway Ferry, Causeway Pier, Roll-On/Roll-Off Platform, Air Cushion Vehicle Landing Platform (ACVLAP), Air Cushioned

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Test Bed for Government SS3 Connector Tests

ONR-funded Logistics Engineering Advanced Demonstration (LEAD)



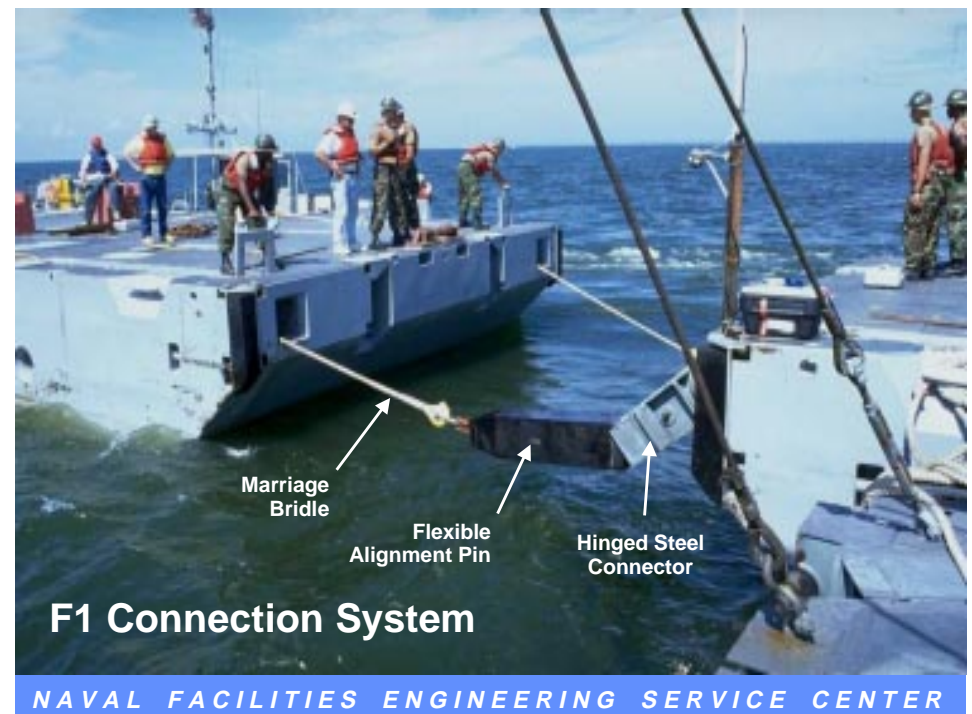
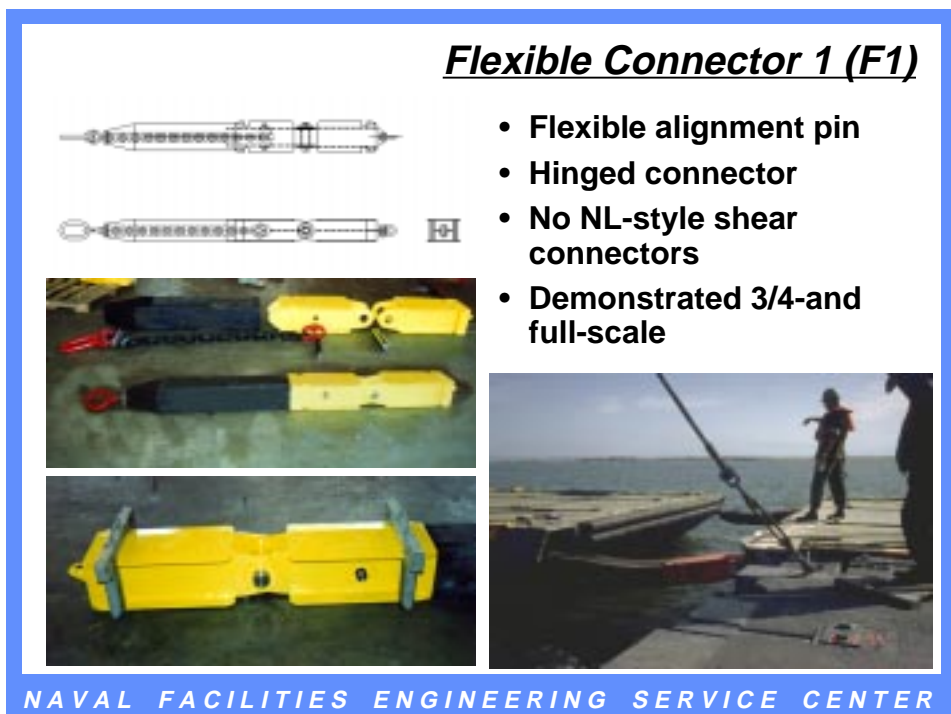
- **24- by 40-ft test beds**
 - 2 Raked
 - 1 Center
 - Seashed footprint
- **Assembled from 8- x 8- x 40-ft intermodal pontoons**
- **Design load based on 160-ft rigid platform**
(twice load of 120-ft rigid platform)
- **Weigh < 60-long tons/ea.**

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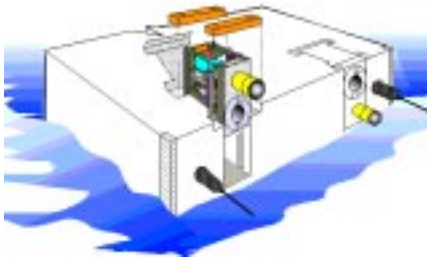
Raked Test Bed being assembled from intermodal pontoons



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Rigid Connector 1 (R1)

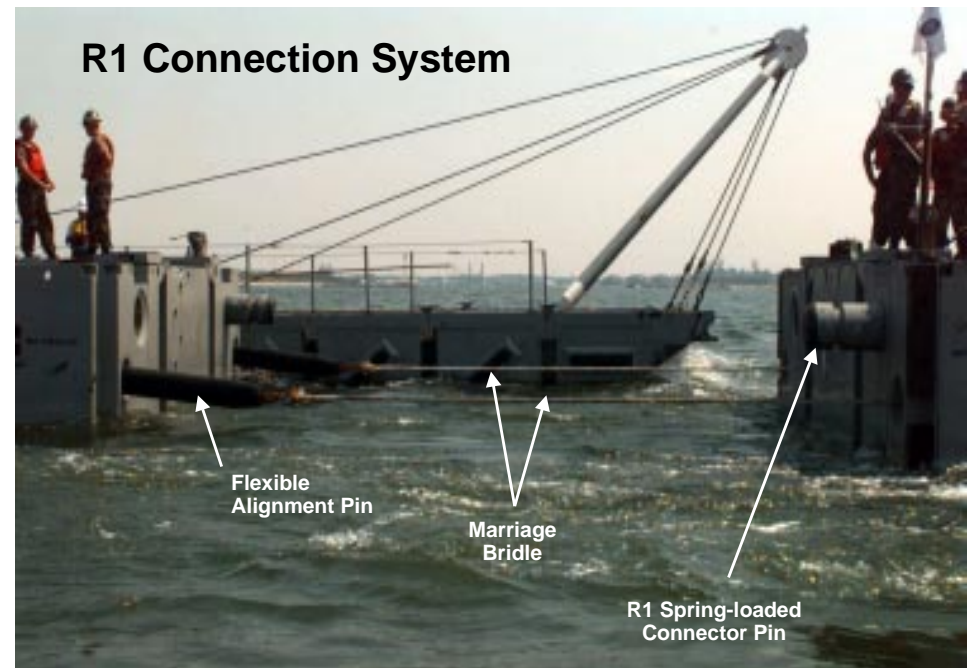


- Flexible alignment pin
- Spring-loaded connector pin
- Assembly removable
- Demonstrated 1/4- and full-scale

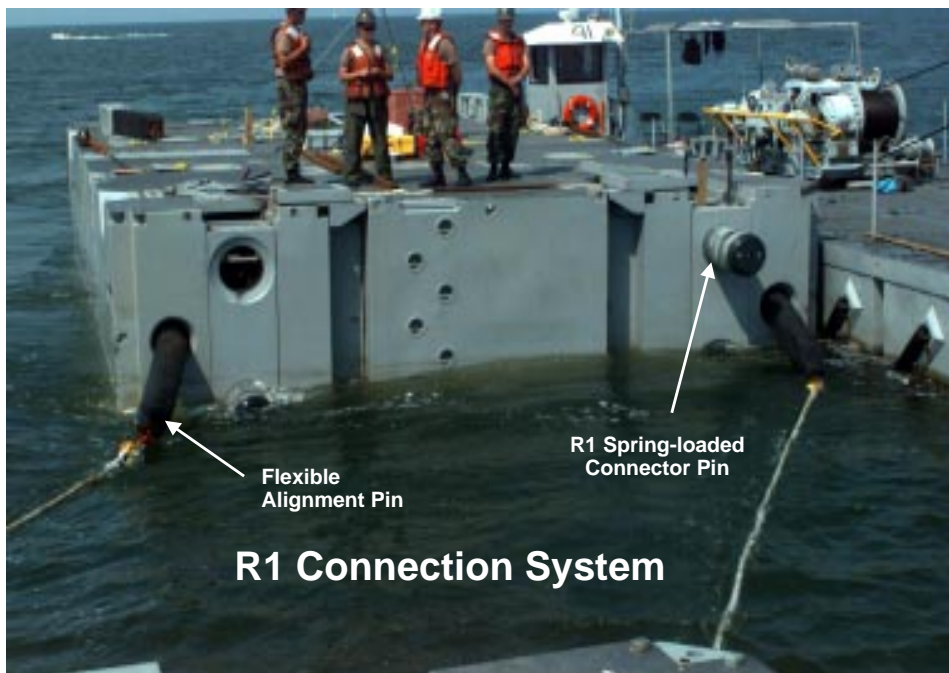


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R1 Connection System



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R1 Connection System

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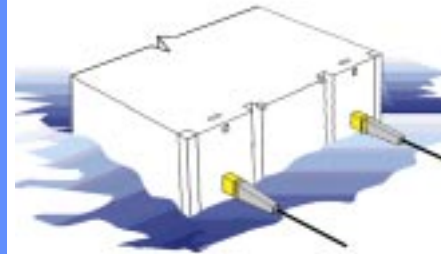
R1 alignment pin in action

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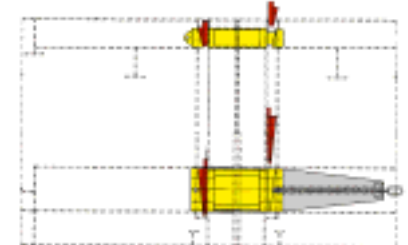
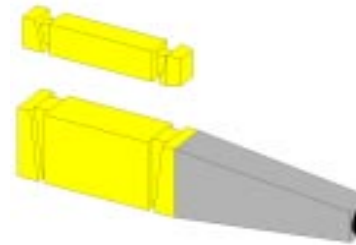


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Rigid Connector 2 (R2)



- Best features of R1 and F1
- Flexible alignment pin
- Simple design w/ few parts
- Lower pin withstands load during assembly
- Virtual & full-scale demos



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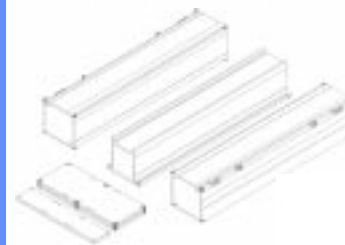


R2 Connection System

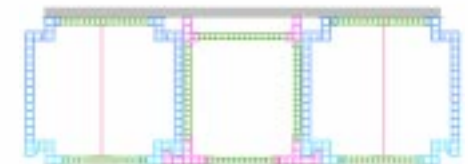
- Lower pin has integral flexible alignment pin and serves as point of contact for marriage bridge
- Lower pin engages first and can withstand full connecting load
- Upper pin extended after lower pin has been locked in place

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Pultruded Composite Causeway (PCC)



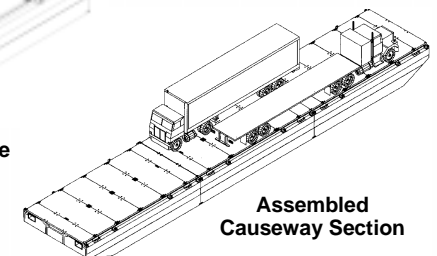
Interlocking modules
and deck plates
ready for assembly



PCC Module Cross Section



Assembled PCC Module



Assembled
Causeway Section

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Pultruded Composite Module Structural Test



Slide Courtesy of CDNSWC

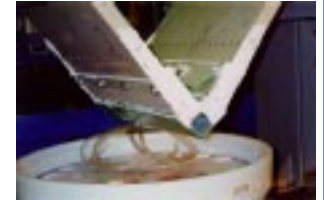
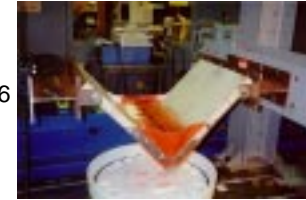
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PCC Watertight Joint Cyclic Load Test

Cycled Between 0.01 - 1.0"
1,000 Cycles Per 0.2" Increments

Destructive Test

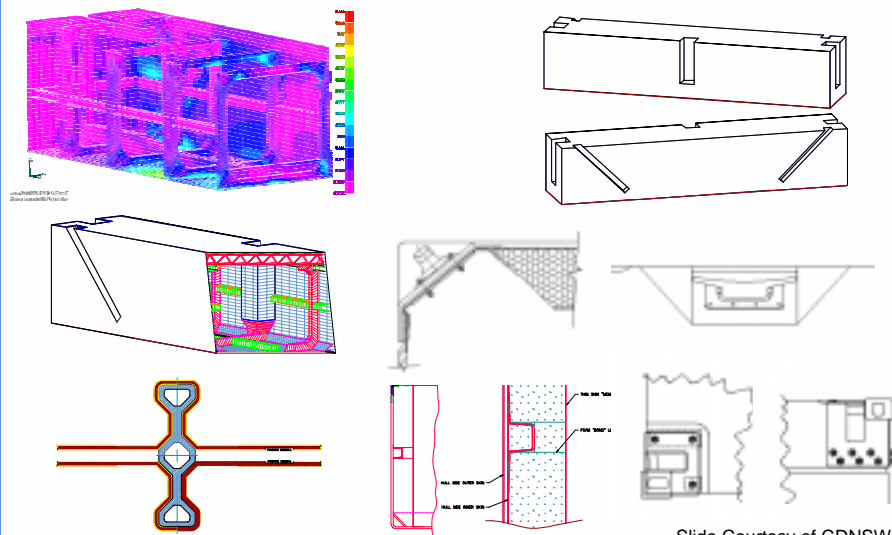
Joint Configuration #1 of 6



Slide Courtesy of CDNSWC

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Hand Lay-Up Composite Causeway



Slide Courtesy of CDNSWC

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Hand Lay-up Composite Module Structural Test



Slide Courtesy of CDNSWC

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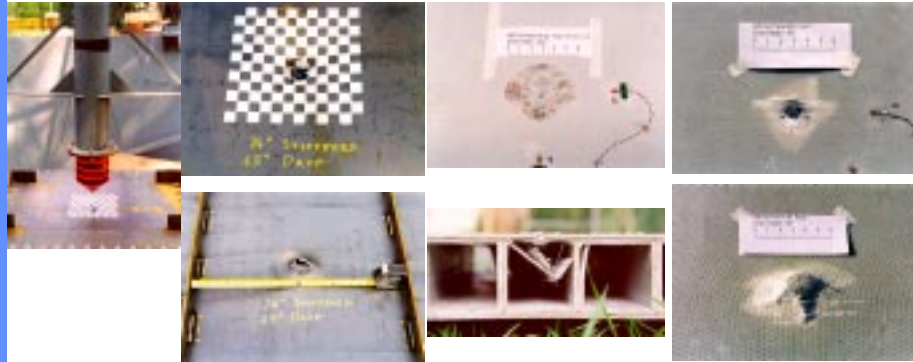
Side Panel Impact Test

Test Setup

Steel
1/4" plate

Pultruded Composite
Cellular Construction

Hand lay-up Composite
Single Skin



Slide Courtesy of CDNSWC

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Joystick Control / Dynamic Mooring

• Purpose

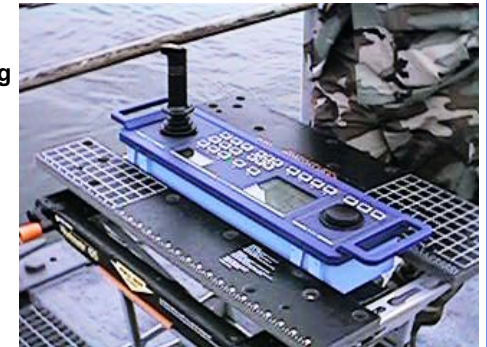
- Provide intuitive control to WT and CF operators
- Eliminate/reduce CF line handling alongside ships and piers

• Status

- Joystick control fully demo'd and considered transitioned
- Initial demo of dynamic mooring conducted Jun 98 @ ACB2

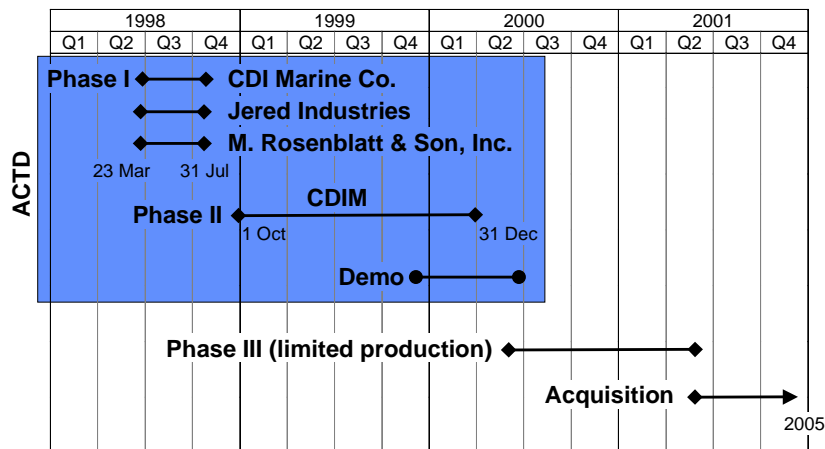
• Plans

- Joystick to be installed aboard Army MCS WT prototype early to mid-FY99
- PHIBCB TWO to use dynamic mooring capability during MPF offload?



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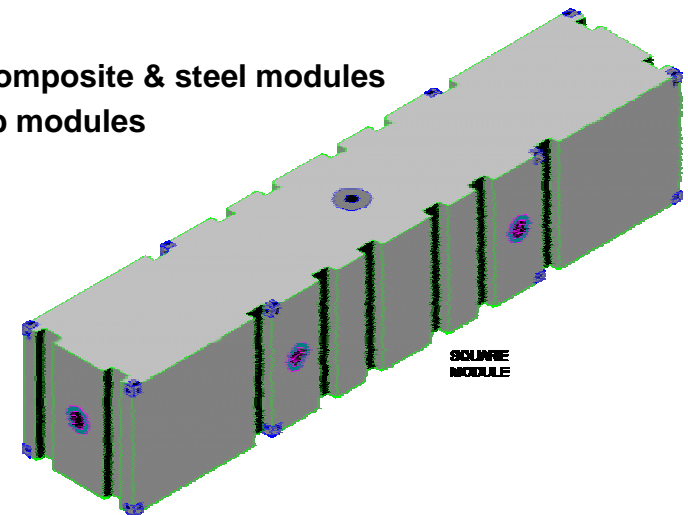
Joint Modular Lighter System (JMLS) Advanced Concept Technology Demonstration (ACTD)



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Jered Industries—Modules

- Mix of composite & steel modules
- 8-ft deep modules



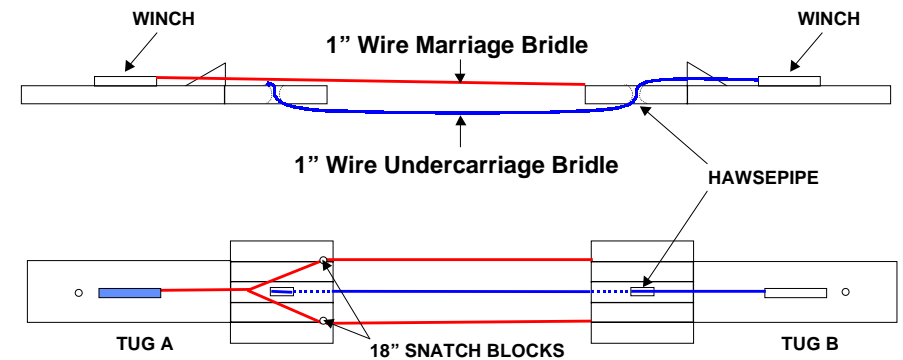
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Jered Industries—Connection System

- **Rigid and Flexible Connectors**
 - Rigid based on Jered's "SS3" ELCAS(M) system
 - Flexible based on Government F1 connector
- **24- by 40-ft and larger "super" modules assembled on deck**
- **In-water assembly with marriage bridge**

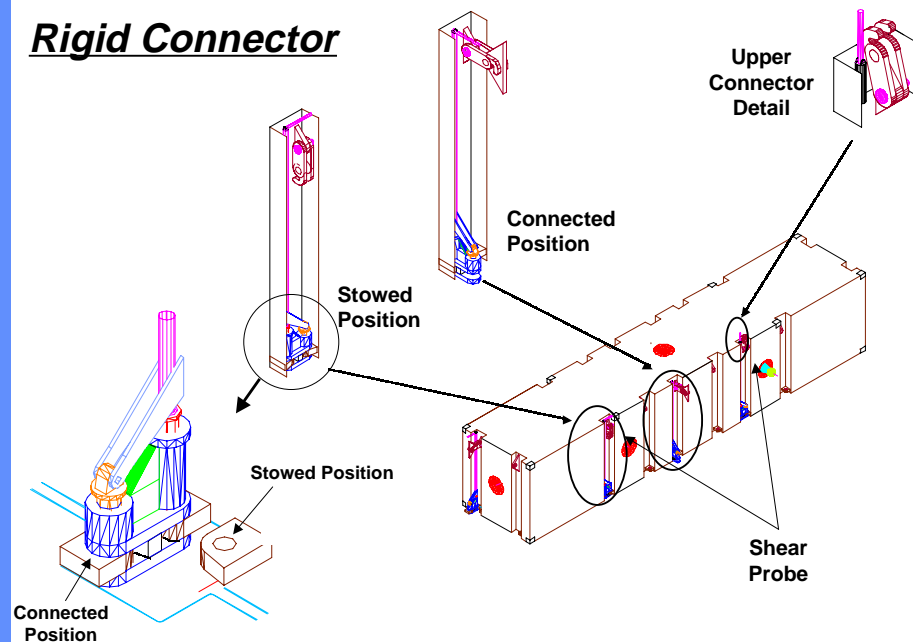
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Jered Industries—Marriage Bridge



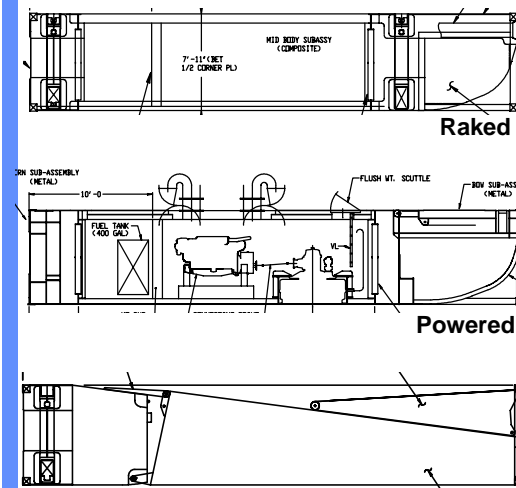
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Rigid Connector



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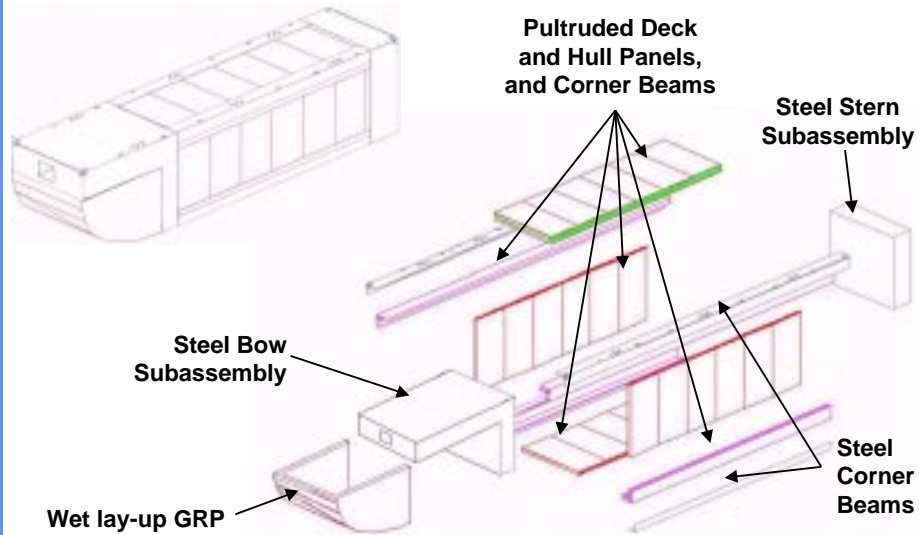
M. Rosenblatt & Son, Inc.—Modules



- **Hybrid composite & steel**
- **8-ft deep modules**
- **3 unique module types**
 - Raked
 - Powered
 - Articulated Ramp

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MR&S—Hybrid Module Design



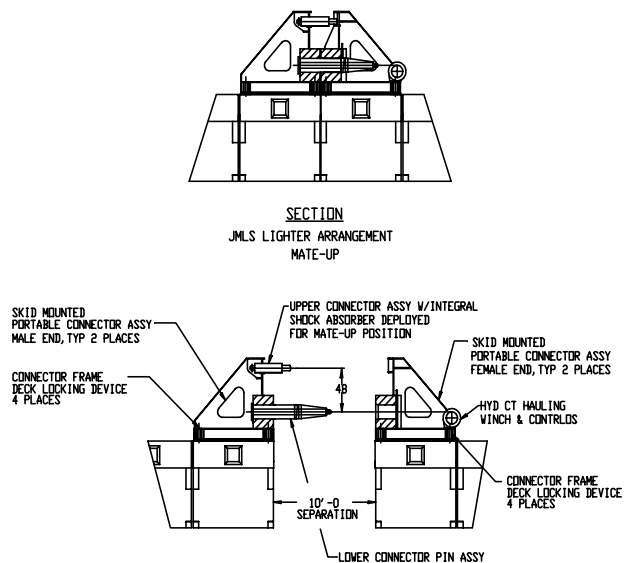
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MR&S—Connection System

- Rigid and flexible connectors
 - Rigid based on MCA connector concept design
 - Flexible based on Government F1 connector
- 24- by 80-ft, 73-long ton sections assembled on deck
- In-water assembly with Portable Mating Device

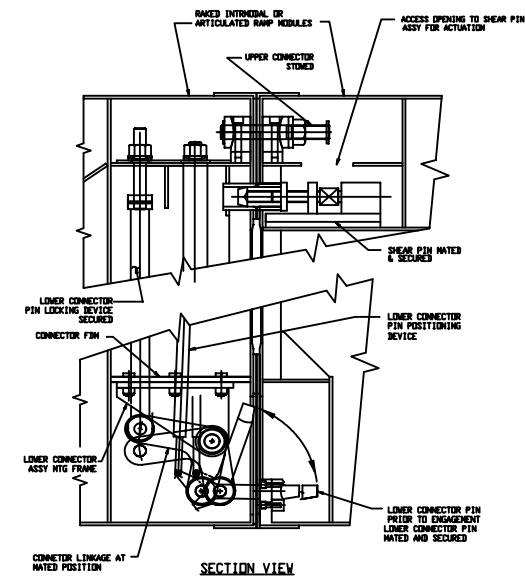
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MR&S—Portable Mating Device



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MR&S—Rigid Connector



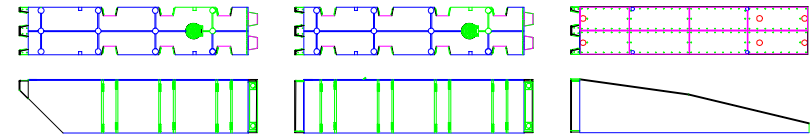
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CDI Marine Company

- **CDI Marine Company (CDIM)**
 - Program Management
 - Detail Design
 - Acquisition Logistics
- **Band, Lavis and Associates** (a new subsidiary of CDIM)
 - Systems Engineering
 - Engineering Tests and Demonstration
- **American Management Systems**
 - Integrated Product and Process Development (IPPD)
 - Integrated Product Data Environment (IPDE)
 - Life Cycle Cost
- **Baltimore Marine Industries**
 - Fabrication

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CDIM—Modules



Powered (Male)

Flat-End

Ramp End (M)

Powered (Female)

Ramp End (F)

Rake End Power Support (M)

Rake End Power Support (F)

Rake End (M)

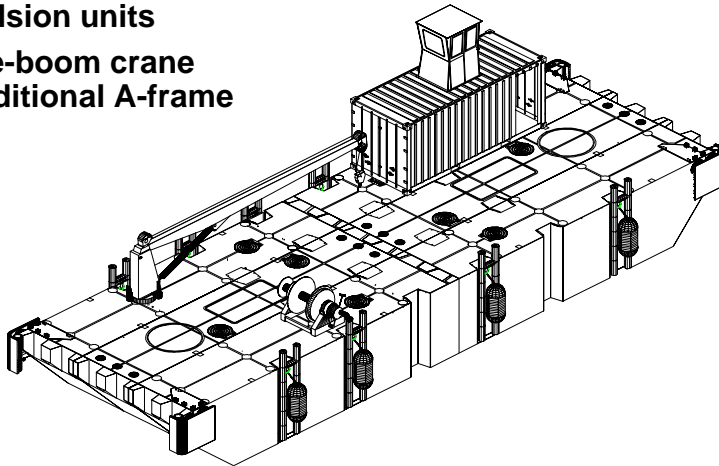
Rake End (F)

- All steel construction
- 9-ft deep modules
- Grit-impregnated UHMW deck sheathing
- 9 unique module types

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CDIM—Warping Tug

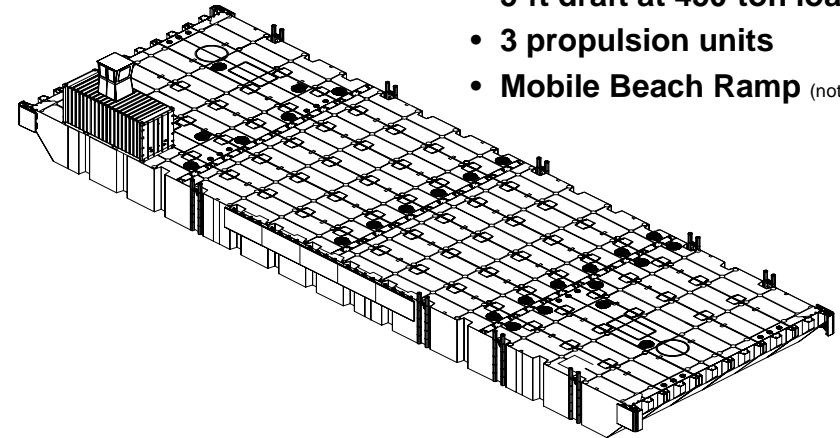
- 78.5- by 24-ft
- 2 propulsion units
- Knuckle-boom crane vice traditional A-frame



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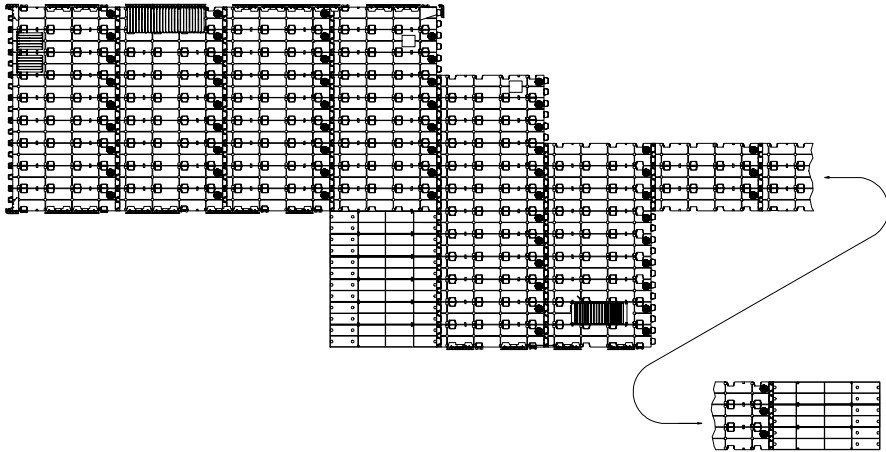
CDIM—Causeway Ferry

- 155- by 48-ft
- 5-ft draft at 450-ton load
- 3 propulsion units
- Mobile Beach Ramp (not shown)



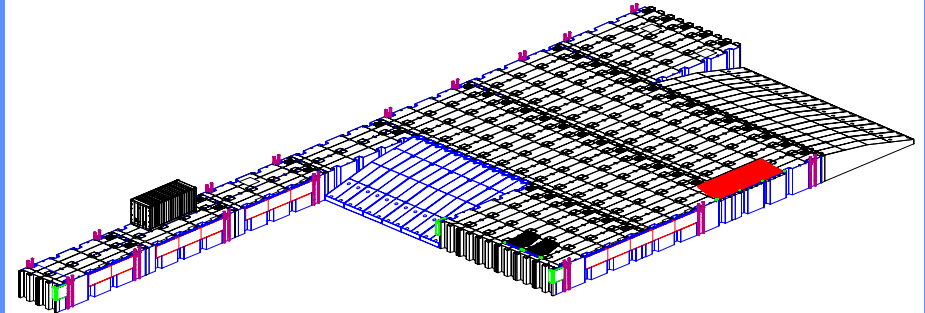
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CDIM—Floating Causeway



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CDIM—Combined RRDF and ACVLAP



Combined platform requires only 12 additional modules

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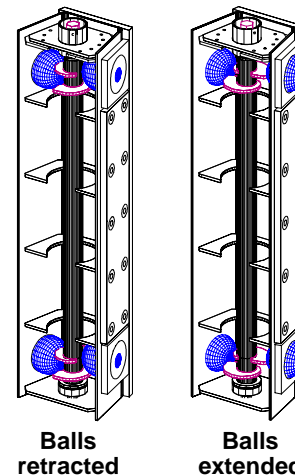
CDIM—Connection System

- All connections are rigid
- Interlocking modules w/ ball-lock connector
- 24- by 40-ft “super” modules assembled on deck
- In-water assembly without marriage bridle
- Phase I risk reduction



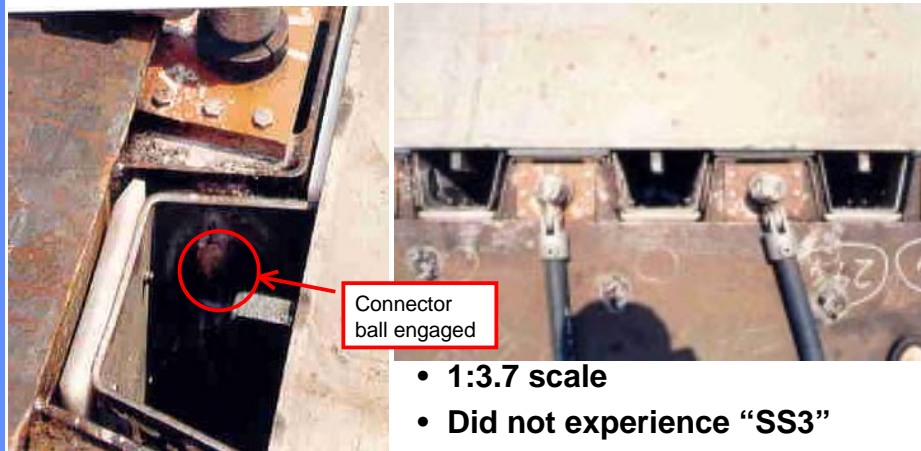
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CDIM—Structural Tests



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CDIM—Subscale Connector Operational Tests



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CDIM—Ancillary Systems

- Mobile Beach Ramp
- Fendering
- Mooring
 - Panama Bitt Fitting
 - Double-Bitt
- Aluminum Finger Ramps

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CDIM—Phase II Demonstration Hardware (Modules Only)

<u>Module</u>	<u>Qty</u>	<u>Description</u>
1&2	5	Powered (Male & Female)
3&4	10	Rake End Power (M&F)
5	59	Flat End
6&7	18	Ramp End (M&F)
8&9	3	Rake End (M&F)
	95	TOTAL

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Significant Differences from Existing Capability

- 8- to 9-ft module depth (SS3-capable)
- Intermodal
- Crew shelters
- Intuitive control of propulsion system
- Proposed extension from 12-yr life
- Deck fittings (mooring bitts, cleats, tie-downs, etc.)
- Air Cushion Vehicle Landing Platform (ACVLAP)

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Summary

- Risk reduction through ONR- and N42-sponsored R&D
- Demo'd critical technologies for SS3 causeway system
 - Intermodal ACBL configuration
 - SS3 connection system
 - Pultruded and hand lay-up composite modules
 - Intuitive control
- Selected for Advanced Concept Tech. Demonstration
 - Completed 3 Phase I efforts (31 Jul 98)
 - Awarded 1 Phase II effort (Sep 98 - Dec 99)
- “Work in progress”

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For Further Information

ACBL & SS3 Connectors

<http://www.nfesc.navy.mil/amphib/causeway/causeway.html>

Composites

<http://navycals.dt.navy.mil/~beech/code20/causeway.html>

JMLS Acquisition

<http://www.ceso.navy.mil/>

JMLS ACTD

<http://www.acq.osd.mil/at/>

Naval Logistics Conference

<http://www.naval-logistics.org>

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